Governance of Energy Innovations

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Abstract Innovation plays an important role in the transition towards a more sustainable energy system. The law is often thought of as an inhibiting factor for innovation. However, legal provisions may also serve to promote innovation. Laws which stipulate favourable conditions for renewable energy sources are an obvious example. Finally, existing laws will often not be suited to accommodate a new technology or business model, and the legislator may be slow in reacting to these new challenges. This increases the importance of government agencies as well as non-state governance.

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Therefore, a closer look at the governance of innovations in the energy sector seems warranted. This chapter will investigate how the legislator, regulatory agencies and private standard-setting bodies are responding to three different energy innovations: new renewable energy sources, new storage systems and smart grids. This chapter will serve not only to analyse commonalities and differences in the approach, but also to identify best practices.

1 Introduction

1.1 Overview

A successful energy transition as envisaged by the Swiss Federal Government's Energy Strategy 2050[1] will not only require major changes in behaviour, but also the market introduction of innovative technologies. The law is often thought to inhibit innovation.[2] In a survey for the German-speaking countries Germany, Austria and Switzerland among energy utility companies, 74% named "regulation" as the biggest obstacle to innovation, closely followed by "political framework" with 71%, making these two by far the most often named factors.[3]

However, the law may also function as a catalyst of innovation. An example are legal provisions that promote renewable energy sources, e.g. by implementing quotas, subsidies or other privileges. Either way, no innovation will succeed if the legal framework discourages its use.[4] The governance[5] of energy innovation not only involves legislative measures, but also those taken by regulatory bodies. These include both governmental regulatory agencies as well as private regulatory bodies, such as industry associations.

This chapter will provide an overview of how the different governing actors in Switzerland have dealt with and are dealing with energy-related innovation. Past treatment of innovation will be explained by a short look at the first electrification as well as the innovation of nuclear energy. Current developments which will be assessed are new renewable energy sources, new storage systems and smart grids. But first, it seems appropriate to provide a concise overview of the different functions the law may serve in relation to (primarily technological) innovation.

[1] Swiss Federal Office of Energy (2018).

[2] For a discussion of the term "innovation" in a legal context, see Schreiber (2019), p. 12 et seq.

[3] BDEW, Ernst & Young GmbH (2015), p. 38. Also cf. Schreiber (2019), p. 1.

[4] For a general discussion of the topic, see Schreiber (2019).

[5] For a discussion on the governance of innovation from a legal perspective, see Hoffmann-Riem (2011a). For a general description of the term, see Schuppert (2008). Concerning the difficulties which legal scholars encounter in dealing with the governance concept, cf. Trute et al. (2008), p. 173, 178 (who are otherwise optimistic); also see the opportunities described by Kötter (2008).

1.2 Law and Innovation

The interrelation between law and technological innovation has been investigated at least as early as the 1970s.[6] However, especially in Germany starting in the mid-to-late 1990s, a broader research interest in law and innovation has taken hold.[7] This "jurisprudential innovation research"[8] distinguishes between different functions that the law serves in relation to innovation.

First, the law has to *enable* innovation.[9] This means that the legal framework does not prohibit the innovation and allows all of the actions which are necessary to implement the innovation.[10] In energy law, the introduction of the Atomic Energy Act (*Atomgesetz*, current title: *Kernenergiegesetz*, SR 732.1) first enabled the innovation of nuclear energy production in Switzerland. Before, the trade restrictions in nuclear fuels made this impossible.[11]

In addition, the law may *stimulate* innovation.[12] This means that the law not only enables the innovation but also incentivizes it.[13] Energy-related examples are legal privileges for renewable energy sources such as quotas, feed-in tariffs etc.[14]

I have argued that when the law prescribes the innovation (or at least a certain level of innovation) in a binding way, it is no longer adequate to refer to this as a mere stimulating function. Instead, I have suggested that one may refer to this as an *enforcement* function.[15] An example of this is *technology forcing*, where the law stipulates requirements which cannot be fulfilled by the existing technologies.[16] This happened when new energy efficiency requirements for lamps effectively outlawed traditional light bulbs in the EU and subsequently in Switzerland.[17]

The law also serves to protect society from *undesired incidental effects* associated with an innovation.[18] This limiting function[19] has traditionally been served by safety regulations and is one of law's traditional functions.[20]

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[6] Schreiber (2019), p. 3 et seq. See for example OTA (1979), p. 45; Stewart (1981).

[7] Hoffmann-Riem and Schmidt-Assmann (1994); Hoffmann-Riem and Schneider (1998); Eifert and Hoffmann-Riem (2002); Hoffmann-Riem (2011a); Gattermann (2012); Hoffmann-Riem (2016).

[8] "*Rechtswissenschaftliche Innovationsforschung*" in German.

[9] The enabling function or "*Ermöglichungsfunktion*" in German.

[10] Cf. Schreiber (2002), p. 235; Schreiber (2019), p. 90 et seq.

[11] Schreiber (2019), p. 91.

[12] The stimulating function or "*Stimulierungsfunktion*" in German.

[13] Schreiber (2002), p. 242; Hoffmann-Riem and Schneider (1998a, b), p. 396; Schreiber (2019), p. 92 et seq. Also cf. Ashford and Hall (2011), p. 272, who call for "legal interventions".

[14] Cf. Schreiber (2019), p. 92.

[15] Schreiber (2019), p. 93 et seq. ("*Durchsetzungsfunktion*" in German).

[16] Gerard, Lave (2005).

[17] Hettich (2015); Nusser (2010); Schreiber (2019), p. 93.

[18] Schreiber (2002), p. 249.

[19] "*Nebenfolgenbegrenzungsfunktion*" in German.

[20] Murswiek (1990), p. 208 et seq.; Schreiber (2019), p. 95 et seq.

The undesired effects of an innovation may be so far-reaching that the legislator decides to ban the innovation altogether. I have argued that this constitutes a new category, the *blocking function*.[21] An example from the energy industry is the ban of nuclear energy in Austria, which never introduced the technology.[22]

Finally, the law's main function is to resolve conflicts. The *conflict resolution function* also becomes relevant with regards to innovation.[23] For example, the new Swiss Energy Act (*Energiegesetz*, SR 730.0) stipulates a national interest in the use of renewable energies in Article 12, which may help to address conflicts with other public interests (such as the environment or landscape conservation).[24]

2 History of Swiss Energy Innovation Governance

A short review of Switzerland's past regulatory responses to innovation will show how the government's approach has changed since the late nineteenth century.

2.1 First Electrification

The first electrification in Switzerland started in the late 1870s and progressed quickly in the 1890s, driven by hydropower plants.[25] However, the legislator remained passive for a long time, only enacting legislation to resolve conflicts between the new power lines and existing telegraph lines (in the latter's favour).[26] This passivity was a conscious choice, as "the final word" on the new technology had not yet been spoken and regulation would therefore have to wait.[27]

Thus, the regulation of the new (and dangerous) technology fell upon private organisations. The Swiss Electrotechnical Association (*Schweizerischer Elektrotechnischer Verein*, SEV) created safety rules for high-voltage installations in 1896.[28] The same association later founded a technical auditing body (Technical Inspectorate, *Technisches Inspektorat*) that even offered inspections of private

[21] "*Blockierungsfunktion*" in German, Schreiber (2019), p. 97 et seq.

[22] At the time when the "*Atomsperrgesetz*" (Federal Act on the ban of using nuclear fission for Austria's energy supply) was introduced in 1978, the Austrian people had already voted against the commissioning of an already-built nuclear power plant in Zwentendorf.

[23] Hoffmann-Riem and Schneider (1998a, b), p. 397; Schreiber (2019), p. 98 et seq.

[24] For a discussion of Article 12 Energy Act, see Gerber (2019).

[25] For an overview of Switzerland's early electrification, see Gugerli (1994a, 1996); Wyssling (1946); see also Föhse (2021).

[26] Wyssling (1946), p. 120, 276; Schreiber (2019), p. 98 et seq.

[27] Sten. Bull 1894 S 321, 327; see also Gugerli (1994b), p. 14; Schreiber (2019), p. 436.

[28] Wyssling (1946), p. 279; Schreiber (2019), p. 436 et seq.

household installations for a fee.[29] Thus, in the absence of government regulation, the private economy supplied its own regulatory system. This also shows that private governance is by no means a new phenomenon.[30] The Swiss Electricity Act (*Elektrizitätsgesetz*, SR 734.0) only entered into force in 1903, two decades after the corresponding British Act was introduced.[31]

The formerly private Technical Inspectorate has now become the Federal Inspectorate for Heavy Current Installations (*Eidgenössisches Starkstrominspektorat*, ESTI). This body is still operated by Electrosuisse, but it has been endowed with a public mandate and can issue administrative decisions (*Verfügungen*, cf. Article 16 para. 2 lit. a Electricity Act).

2.2 Nuclear Energy

In stark contrast to the first electrification, the introduction of nuclear energy was not passively observed by the legislator. As mentioned in Sect. 1.2 above, there could not have been an introduction of this innovation without the legislator's initiative, since trade restrictions on nuclear fuels hindered the private market participants.

As nuclear energy was heralded as the solution to the world's energy problems, the Swiss legislator was poised to move quickly. The legislator intervened at the earliest possible stage by promoting research in nuclear energy.[32] The constitution was amended to allow for rules at the federal level, since the topic of nuclear energy was deemed to be of national significance.[33] Also, regulatory oversight had to take place at the federal level, since in the early stages of the technology, not enough experts would have been available to staff a large number of cantonal authorities.[34] On the basis of this new federal legislative power, the Atomic Energy Act entered into force in 1960.

The initial intent of the new law was to promote nuclear energy, corresponding with the enabling and stimulating function of innovation-related law (see Sect. 1.2

[29] Wyssling (1946), p. 280; Schreiber (2019), p. 437.

[30] Contrary to the apparent opinion of Benz (2004a), p. 13 et seq., who seems to emphasize actual changes in the governance responsibilities between government and private actors as one of the reasons for the popularity of the term "governance".

[31] Electric Lighting Act 1882, 45&46 Vict c 56. See Gugerli (1994b), p. 13 et seq.; Schreiber (2019), p. 437.

[32] The legislative materials for the necessary changes to the Swiss constitution concluded that without significant public involvement, even research into the new technology would be doomed to failure. See Federal Council (1957), p. 1159 et seq.; Schreiber (2019), p. 438.

[33] Art. 24quinquies of the former (1874–2000) constitution was adopted to grant legislative powers regarding nuclear energy to the federation. See Federal Council (1957), p. 1139; Schreiber (2019), p. 438 et seq. The same content is now found in Art. 90 Federal Constitution (*Bundesverfassung der Schweizerischen Eidgenossenschaft*).

[34] Federal Council (1957), p. 1139.

above). Thus, rules on the procurement of nuclear fuels provided a legal framework in which, for the first time, nuclear energy could be exploited in Switzerland (*enabling* function).[35] Also, massive public investments into nuclear energy research and development were made possible under the new legal provisions (*stimulating* function).

However, the new laws were not only intended to promote this innovation. Instead, the potential risks of nuclear energy were already well-known. Hence, the new legislative framework was also created to reduce these risks as much as possible.[36] This corresponds with the *limiting* function of the law. For example, the construction of nuclear energy installations was made subject to a detailed approval procedure.[37] The Atomic Energy Act also introduced liability provisions.[38] Still, even here the promotion of the new technology was part of the focus, since the liability was limited.[39]

In addition, the Atomic Energy Act established the supervision of all nuclear energy installations at the federal level. Therefore, there was no need for industry associations to establish their own regulatory bodies.

Finally, it is interesting to note that some hesitance by the federal legislator to regulate a completely new technology can be noticed as well. For example, the legislator saw the problems of having to use exact legal definitions at a time when much of the relevant terminology was still in flux.[40] This problem was diminished by defining several technical terms at the ordinance level, which made it easier to quickly make amendments as they became necessary.[41] This is a legislative technique that is still used frequently today when regulating innovative technologies[42] and that was also part of the regulation during the first electrification.[43] At the same time, it also raises questions as to which parts of the regulation are so important that under constitutional law, they must be implemented in a formal (parliamentary) law.[44] In general, however, the Swiss legislator was much more willing to regulate nuclear energy in its infancy, compared to the "wait-and-see" approach favoured during the first electrification.

The Atomic Energy Act has been replaced by the Nuclear Energy Act, which entered into force in 2005. The regulatory oversight is currently exercised by the Federal Nuclear Safety Inspectorate (*Eidgenössisches*

[35] Schreiber (2019), p. 439.

[36] Federal Council (1957), p. 1139, 1141 et seq.; Federal Council (1958), p. 1522 et seq.

[37] In Articles 4–7, see Federal Council (1958), p. 1538 et seq.

[38] In Article 11, see Federal Council (1958), p. 1544 et seq.

[39] Federal Council (1958), p. 1544 et seq.

[40] Federal Council (1958), p. 1535 et seq.

[41] Federal Council (1958), p. 1535 et seq.

[42] Schreiber (2019), p. 79, 392.

[43] Schreiber (2019), p. 393.

[44] Regarding the general question of which rules may be implemented in an ordinance, see Müller (2020), p. 48 et seq.

Nuklearsicherheitsinspektorat, ENSI). This demonstrates the importance of regulatory agencies not only for competition-oriented market regulation, but also for safety regulation (cf. the *ESTI* discussed in Sect. 2.1 above).

2.3 Interim Conclusions

The comparison between the regulatory approaches to the first electrification and the introduction of nuclear energy has shown remarkable differences. During the first electrification, the legislator remained largely passive. The regulation of high-voltage installations was therefore first implemented by the private sector through industry associations. These associations later played an important part in the preparation of the first electricity-specific laws.[45]

In contrast, the peaceful use of nuclear energy was accompanied by the legislator from the very beginning. This included provisions to support research and development. The regulation and supervision took place at the federal level from the start, due to the significance of the innovation and the potential risks involved. The public sector was thus deeply involved in the new industry, and there was little room for private self-regulatory[46] governance.

What is the reason for the difference in these two approaches? The first electrification did not collide with many legal provisions since the overall "regulatory density"[47] was not nearly as high in the late nineteenth century as it is today. Thus, the private market participants were able to employ the new technology without facing prohibitory restrictions.

On the contrary, nuclear energy faced a prohibitory legal framework that prevented the private industry from ever implementing the new technology without government intervention. Since even the trade of nuclear fuels was prohibited, a completely new legal framework was necessary in order to enable the innovation.

It may be presumed that, given the ever-increasing regulatory density especially in the energy sector, current innovations will rather fall into a similar category as nuclear energy. This would mean that the legislator would interfere at an early stage, maybe even before the innovation has entered the market. The following discussion of current innovation governance in the energy sector will, among other things, shed light on this question.

[45] Wyssling (1946), p. 281 et seq.; Schreiber (2019), p. 437.

[46] For discussion of self-regulation, see Hettich (2014), p. 269 et seq.

[47] For a discussion of this term, see Citi, Justesen (2014), p. 713 et seq., 716 et seq.

3 Governance of Current Energy Innovations

3.1 New Renewable Energy Sources

The term "new renewable energy sources" is used in Switzerland to designate all renewable energies other than the long-established hydropower.[48] Increasing the production from new renewable energy sources has been one of the main focuses of the Swiss Energy Strategy 2050.[49] Several options exist to promote renewable energy production, including quotas[50] and auctions.[51] The Swiss legislator opted for a feed-in tariff system, the "feed-in remuneration at cost" (*Kostendeckende Einspeisevergütung*, KEV).[52] In recent years and with the introduction of the completely revised Energy Act in 2018, the system has taken on a more market-oriented approach. Under the new feed-in tariff system (*Einspeisevergütungssystem*, EVS), renewable energy producers, as a basic principle, have to directly market the electricity they produce (Article 21 Energy Act).[53]

Thus, the federal legislator has played a crucial role in the promotion of (new) renewable energy sources. This is complemented by cantonal and municipal subsidies for renewable energy installations, especially for solar heating in households.[54]

However, the multi-level governance[55] of renewable energy not only extends to provisions that promote this innovation. Often, authorities at the cantonal or municipal level will be tasked with the implementation of other provisions that *interfere* with renewable energy projects. With regards to solar installations, for example, the federal legislator has introduced Article 18a of the Spatial Planning Act (*Raumplanungsgesetz*, SR 700). In its current version, the provision stipulates that certain well-integrated rooftop solar systems do not need a building permit. This—constitutionally controversial[56]—provision was partly a response to the strict application of cantonal and municipal rules for listed historic buildings and townscape protection (*Denkmal- und Ortsbildschutz*). The tensions between the federal legislator's intent to promote solar energy and the cantons' and municipalities' wish to

[48] Cf. Article 2 para. 1 Energy Act (*Energiegesetz*), which does not use the term "new renewable energy" but still only applies to all renewable energy sources "except for hydropower".

[49] Federal Council (2013), p. 7594.

[50] Which have notably been used in the UK for a long time under the "renewables obligation" scheme.

[51] Such as those now used in Germany under the Renewable Energy Sources Act (*Erneuerbare-Energien-Gesetz*—EEG 2017).

[52] For a critical assessment of the KEV system, see Hettich and Walther (2011).

[53] For a detailed discussion of the Swiss feed-in tariff system, see Haelg et al. (2021).

[54] A list of the available support schemes can be found on the website https://www.energie-experten.ch/de/energiefranken.html.

[55] For a general discussion of this concept, see Benz (2004b). In the context of the energy transition, see Thaler et al. (2019).

[56] Cf. Hettich and Peng (2015). For a more general discussion, see Müller and Vogel (2012).

protect their townscapes are a good example of problems inherent in multi-level governance.[57]

3.2 New Storage Systems

With the rising share of variable renewable energy sources, at some point in the future, storage capacity may be needed.[58] Until recently, the only large-scale storage technologies were pump hydropower storage systems. With the increasing need for storage capacity and the lack of suitable locations for new pump hydropower plants, new energy storage technologies (e.g. batteries, compressed air storage or even Power-to-Gas)[59] will become more relevant.

Compared to some other countries and the EU,[60] the Swiss legislator has so far remained relatively passive in the governance of new storage systems.[61] One important obstacle for new storage technologies is the existing legal framework for pump hydropower storage. Pump hydropower is exempted from the final consumer status under Article 4 para. 1 lit. b Electricity Supply Act (*Stromversorgungsgesetz*, SR 734.7). This, most importantly, means that pump hydropower plants do not have to pay grid fees under Article 14 Electricity Supply Act. If—as I have argued[62]—this exemption did not apply to new storage technologies, that would be a major impediment to the diffusion of new storage systems.

The Federal Council had originally planned to clarify that all storage systems with the exception of pump hydropower plants are final consumers.[63] This provision was later removed from the draft ordinance due to negative responses in the consultation.[64] Since the executive level of governance therefore refrained from clarifying the legal status of storage systems, this burden now falls back on the legislator.

Meanwhile, the private Swiss Association of Electric Power Producers and Distributors (*Verband Schweizerischer Elektrizitätsunternehmen*, VSE) has published a "Handbook Storage", which stipulates that storage systems that take electricity from the public grid and later feed electricity back into the grid at the same

[57] Also cf. Thaler et al. (2019), p. 3.

[58] See Schreiber (2019), p. 167 et seq. Only a long-term need for storage is seen by Hewicker et al. (2013). For a detailed discussion of storage-related governance, see Walther (2019).

[59] For a detailed description of new storage technologies, see Sterner and Stadler (2017).

[60] Cf. Schreiber (2019), p. 276 et seq., 409, 427 et seq.

[61] Also cf. Kratz (2018); Walther (2019).

[62] Schreiber (2019), p. 234 et seq. But cf. Kratz (2018), p. 73, 94 et seq.; Walther (2019), p. 30.

[63] In a revised Article 2 para. 3 Electricity Supply Ordinance (*Stromversorgungsverordnung*), see Federal Department of the Environment, Transport, Energy and Communications (2018), p. 6.

[64] Schreiber (2019), p. 276. For the statements from the consultation, see "*Strategie Stromnetze: Änderungen auf Verordnungsstufe*", available at https://www.admin.ch.

location should be exempt from paying grid fees.[65] This is particularly noteworthy as under the Swiss principle of subsidiarity, private industry associations play an important role in energy governance (Article 3 Electricity Supply Act). It may therefore be argued that, where the legislator does not provide clear stipulations, the industry association's interpretation of the law should prevail.[66] The regulatory agency ElCom has recently confirmed the VSE's interpretation,[67] while the Federal Council still pursues plans to explicitly state in the law that only pump hydropower plants are exempt from grid fees.[68]

Regardless of how binding the industry association's rules are, they are another good example of private (self-regulatory) governance in the absence of specific legislation.

In addition, regulatory authorities may become important for storage systems as well. If grid operators were allowed to install their own storage systems (which is currently unclear under unbundling rules),[69] the question would arise whether the costs could be recovered under the Swiss "cost-plus" regulation (Art. 15 Electricity Supply Act). The regulatory agency ElCom has in the past refused to accept costs for certain innovative measures as they were not seen as "currently" necessary.[70] The same problem may arise with investments in storage capacity that may only be truly needed in the future. This shows that a conservative approach by regulatory agencies may inhibit innovation in regulated industries.

3.3 Smart Grids

In a new, more sustainable energy industry with decentralised, variable renewable energy sources, storage systems and "prosumers" that produce as well as consume electricity, digital technology may help to connect all these different market actors. In such a "smart grid", information on energy demand and production, the current grid situation and other important data could be used, inter alia, to match electricity production and consumption despite the variability of renewables.[71]

However, the vast amount of data necessary for such a smart grid has led to data protection concerns.[72] The governance of smart grids must therefore take into

[65] Verband Schweizerischer Elektrizitätsunternehmen (2017), p. 8.

[66] See Walther (2019), p. 30. But cf. Schreiber (2019), p. 266 et seq.

[67] Electricity Commission (2020), p. 17 et seq.

[68] Swiss Federal Office of Energy (2020), p. 5.

[69] Kratz (2018), p. 96 et seq.; Walther (2019), p. 11 et seq.; Schreiber (2019), p. 361 et seq.

[70] See Electricity Commission (2011) for smart grid technology. Also cf. Walther (2014), p. 171 et seq.; Schreiber (2019), p. 381 et seq.

[71] For the potential uses of smart grid technologies in Switzerland, see BET Dynamo Suisse (2014).

[72] See McKenna et al. (2012).

account both the stimulating as well as the limiting functions of innovation-related law.

The Swiss federal legislator has chosen exactly this two-pronged approach. On the one hand, the law stimulates and, to a significant extent, even enforces the implementation of smart grid technology. The latter aspect especially applies to smart meters. Here, the law enforces a smart meter rollout, according to which grid operators have to replace 80% of the meters in their grid area with smart meters by January 1, 2028 (Article 17a para. 2 Electricity Supply Act, Articles 8a, 31e and 31l Electricity Supply Ordinance).

On the other hand, the law also fulfils a limiting role with regards to the potential dangers that a smart grid poses for data protection. Real-time electricity consumption data could be used to learn about a household's income, the number and age of people in the household and the times at which a house is left empty.[73] For this reason, Article 17c Electricity Supply Act declares that the federal Data Protection Act is applicable to all smart metering data.[74]

In addition, Article 8b Electricity Supply Ordinance demands that all smart metering systems have been successfully tested for their data security by the Federal Institute of Metrology. Article 8d Electricity Supply Ordinance stipulates in which manner the data may be used. Inter alia, the time resolution may only be fifteen minutes or more (para. 1) and personal data may generally only be used in pseudonymised or aggregated form (para. 2). However, such data usage does not require the respective person's consent. This makes large-scale use of smart metering data practically feasible and thus serves a stimulating function.

3.4 Interim Conclusions

The survey of current energy innovations has shown two different approaches: With new renewable energy sources and smart grids, the legislator has played an early role in promoting these technologies. This is reminiscent of the historic approach to nuclear energy. For smart meters, the federal law has even implemented a mandatory roll-out. This shows that the law has partially evolved from a mere stimulating tool for innovation to an enforcer of innovation.

However, in the case of new energy storage systems, the Swiss legislator has taken a much more cautious approach. So far and unlike in some neighbouring

[73] Newing et al. (2015); Anderson et al. (2017).

[74] This is relevant since the number of privately organised but publicly (often at the cantonal level) dominated energy utility companies leads to the question whether cantonal or federal data protection laws are applicable. The federal law only applies to data handled by private persons or federal authorities, Article 2 para. 1 Data Protection Act (*Bundesgesetz über den Datenschutz*). Therefore, it does not apply to data handled by cantonal authorities. The latter are governed by the cantonal data protection laws.

countries,[75] no storage-specific supportive legislation has been implemented. As has been shown, the first (and ultimately aborted) attempt to regulate storage systems was intended to cement the existing special status of the incumbent technology, pump hydropower storage. In the absence of legal provisions, a private industry association has introduced rules on storage systems in a technical document. This legislative passivity, coupled with an increased governance role of private institutions, is similar to the first introduction of electricity in Switzerland.

4 Best Practices of Innovation Governance

The different historic and current governance approaches to innovation lead to the question whether best practices can be identified. While more research seems warranted, the following section will highlight some key factors.

4.1 Analysis of the Existing Framework

When deciding on whether a proactive or a passive legislative approach should be chosen, the existing legal framework must be taken into account. A passive approach will only work if the existing framework allows the innovation to be implemented. If the existing rules prohibit the innovative solution or render it economically unattractive, a passive approach will likely prevent the innovation's widespread adoption. Hence, the first electrification of Switzerland was possible despite the legislator's passivity, since no existing laws prevented the innovation from being implemented.

Contrary to this, a similar approach would not have been possible with nuclear energy, since existing international rules prevented fuels from being obtained by private market actors. Therefore, the existing legal framework must be analysed as to its impact on the innovation. If the innovation seems desirable but the existing framework would severely hinder its implementation, a passive approach is not a feasible option.[76]

In this context, it should also be noted that minor changes to the existing framework which remove the legal obstacles might be preferable to specific support schemes or other legal privileges for the innovation.[77]

[75] See § 111 para. 3 of the Austrian *Elektrizitätswirtschafts- und -organisationsgesetz* 2010; § 118 para. 6 of the German *Energiewirtschaftsgesetz*.

[76] Cf. Schreiber (2019), p. 441 et seq.

[77] Schreiber (2019), p. 389 et seq.

4.2 Technology-Neutral Rules

When a decision is made to enact legislation to support (or, in the case of negative effects, limit) the innovation, the exact design of the new rules is critical. For example, if legal privileges are introduced for a narrowly defined innovation, other (potentially better) technologies may not benefit from these. This would grant an unfair advantage to the innovation supported by the legislator. The rules should therefore be technology-neutral to ensure fair competition that leads to the best market outcome.[78]

That is why, for example, legal definitions should be broad enough to include not just the specific innovation but also other innovative options. This is also important since new technologies may be invented faster than the legislator can react. This is commonly referred to as "legal lag".[79] The rules should thus also take into account potential new inventions that are not yet available when the rules are drafted. One could call these "technology-open" rules.[80]

4.3 Flexibility

The "legal lag" problem just described above is often coupled with another phenomenon: the lack of knowledge on the legislator's part. The legislator cannot know in advance whether an innovation will be successful or whether new, even better technologies or processes will be introduced in the future.[81] For this reason, the legislator will often prefer flexible rules at the ordinance level that can be quickly adapted to changing circumstances.[82] Despite the advantages that ordinances offer in terms of flexibility, the principle of legality demands, inter alia, that the basic stipulations are contained in a formal (parliamentary) enactment (*Gesetz im formellen Sinne*).[83] The ordinance's comparative lack of democratic legitimation may also become a political burden when compared with parliamentary enactments.

[78] Cf. Kratz (2018), p. 46, 228 et seq.; Hettich et al. (2017), p. 177 et seq.; Schreiber (2019), p. 391.

[79] This term has been used, inter alia, in the context of product liability rules concerning innovative products; Zech (2016), p. 15 et seq.; Vieweg (2011), p. 337.

[80] Sailer and Reuter (2014), p. 13; Schreiber (2019), p. 390.

[81] Stewart (1981), p. 1275; Hoffmann-Riem (2011b), p. 316; Schreiber (2019), p. 75 et seq.

[82] Schreiber (2019), p. 392 et seq.

[83] For a discussion of the principle of legality in the context of energy law, see Jagmetti (2005), p. 108 et seq.; Petrik-Haltiner (2017), p. 14 et seq. In the context of innovation, see Schreiber (2019), p. 101 et seq.

4.4 Multi-Level Governance

Another important decision is whether the innovation should be regulated at the federal, cantonal or municipal level. Often, this decision will be shaped by the constitutional definition of competencies and responsibilities. However, some ground-breaking innovations may even justify changes to the constitutional framework, as was the case with nuclear energy in Switzerland. Where competing federal and cantonal competencies exist, the federal legislator must decide whether to act on its powers and therefore preclude conflicting cantonal rules.

One advantage of federal laws may be that the innovation will face the same legal framework in the entire country. This might help with standardisation and could increase investors' confidence. However, cantonal or municipal laws may have the benefit that several legal frameworks could compete with one another. "First-mover" cantons or municipalities would be able to implement new rules, which could then be observed by the others. This might enable a competition to see which rules best aid the innovation's implementation.

Cities are often especially interested in innovations and offer the advantage of many potential users who might adopt the innovation, as well as an advanced infrastructure. They thus seem like a well-suited "playground" for new innovations. It may therefore be desirable to allow cities to adopt specific rules to help with a new innovative project. This is only possible where federal and cantonal laws provide enough room for municipal enactments.

Despite the potential advantages of multi-level governance with regards to innovation, the Swiss energy sector has seen a steady development towards more centralised rules at the federal level in recent decades.[84] This calls into question to which degree these potential advantages may actually be exploited.

4.5 Public or Private Governing Bodies

In the absence of legislation, private bodies may offer a good alternative to implement rules on the innovation. Private governing bodies such as industry associations often have more information on the innovation than the legislator and they understand better how it might be implemented. They can therefore draft rules which fit the innovation very well.

However, the involvement of private governing bodies may also have disadvantages. For example, established industry associations may seek to hinder innovations that they regard as threatening to their business models.[85] For a simple thought experiment to illustrate this, just imagine the taxi drivers' union drafting rules on

[84] See Föhse (2021).

[85] Cf. Schreiber (2019), p. 86.

Uber.[86] The problem of incentives is exacerbated where private associations do not represent all market actors.[87]

In addition, private rule-making may raise questions as to the rules' validity. The existing legislation may be unclear on the subject of the innovation. When private associations implement rules, it becomes difficult to judge whether the law does indeed make stipulations on the innovation or whether there was sufficient room for the private body to create its own rules. This is the case for storage technology, where it seems questionable whether the VSE's rules are compatible with the existing laws.[88]

It is also worth noting that there is no strict dichotomy between private and public governing bodies. An example of this, which has been discussed here, is the safety regulatory agency for the electricity market, the *ESTI*, which was originally founded as part of a private technical association but which has now been granted powers similar to those of a government institution.

5 Conclusions

The governance perspective draws attention to the interplay of state and non-state actors at multiple vertical and horizontal levels. The discussion has shown that these factors also affect the relationship between law and innovation in the energy sector.

While some energy innovations were driven by legislation early on, others met a mostly passive legislator. In these cases, private governing bodies such as industry associations have played an important role in shaping the innovation's regulatory environment. The interplay between private and public actors becomes especially apparent when formerly private institutions are endowed with regulatory powers by the state, as was the case with the *ESTI*.

Innovation may be governed effectively at multiple vertical levels, which could lead to a competition between different cantons and municipalities as to the most innovation-friendly legal framework. However, a disadvantage is the potential patchwork of laws that might deter investments. Also, different priorities between the federal, cantonal and municipal level may cause problems, as was the case with photovoltaic installations. In recent years, the energy sector has witnessed a development towards more laws at the federal level, with less and less room for cantonal laws.

The "regulatory density" in the energy industry has increased significantly in the last few decades. For this reason, a legislative "wait-and-see" approach as favoured

[86] Regarding the regulatory environment for Uber in Switzerland, see Abegg and Bernauer (2018); Meier (2018); Riemer-Kafka and Studer (2017); Sieber-Gasser (2017).

[87] Cf. Schreiber (2019), p. 273 et seq.

[88] See Walther (2019), p. 30, on the one hand and Schreiber (2019), p. 267 et seq., 275, on the other hand.

during the early electrification may no longer be feasible. Where innovative technologies and business models meet legal provisions that were never intended to govern them, changes to the legal framework may be inevitable in order for the innovation to succeed.

Despite this apparent need for regulatory intervention, it is crucial to design technology-neutral rules that do not favour any specific innovation over another and that are open to future developments. Otherwise, laws and regulations may drive an inferior solution's success while blocking more innovative approaches.

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